

# Application and Evaluation of the Multi-dimensional Knowledge Framework Approach

Roger Böhlen

Knut Hinkelmann

Alpiq Management AG  
Bahnhofquai 12  
4600 Olten, Schweiz  
roger.boehlen@alpiq.com

Fachhochschule Nordwestschweiz FHNW  
Hochschule für Wirtschaft  
Riggenbachstrasse 16  
4600 Olten, Schweiz  
knut.hinkelmann@fhnw.ch

**Abstract:** This paper discusses the application and evaluation of the multi-dimensional knowledge framework approach on a real life case study. In a first stage the framework is explained and the case study where the framework is assessed is described. At the end it is evaluated if the framework helps to identify strengths and weaknesses which can be exploited to improve knowledge maturing in an organisation.

## 1 Introduction

Knowledge maturing has been identified by Schmidt as a unifying concept for knowledge management and learning [Sch05]. It illustrates the development from new ideas to consolidated knowledge. The maturing can be supported by methods and tools well-known from knowledge management like knowledge identification, sharing, acquisition, or generation.

However, when starting projects and initiatives for knowledge maturing and to assess the potentials of these initiatives, questions like the following have to be answered: Where do we stand with regard to knowledge use and learning? How can we support and improve knowledge maturing? What are appropriate learning methods for our company? Which methods and tools can be applied in our environment? The answers to these questions depend on a variety of influencing factors.

Brun et al. proposed a multi-dimensional framework to assess the potentials for knowledge maturing in the context of an enterprise [BHTT09]. Unlike methods as Intellectual Capital reports (e.g. [Nem06], [ABW08], [MAH05]), the knowledge maturing framework does not assess the value of knowledge for an enterprise but analyses the context of knowledge management in order to find means to improve it.

The question to be answered with this research is whether the results from applying the knowledge maturing framework allow us to explain problems of knowledge management. If the answer is "yes", then this would indicate that the dimensions and measures of the framework are suitable. It is not the intention of this research to compare

different assessment frameworks for knowledge maturing or knowledge management, but to assess the applicability and usefulness of the single maturing framework of Brun et al. The approach for this research is an in-depth study of a specific case. We applied the framework to a concrete project doing an a posteriori evaluation of the problems and issues identified.

## 2 The multi-dimensional knowledge assessment framework

The multi-dimensional knowledge assessment framework [BHTT09], developed in the MATURE project, gives answers concerning the actual knowledge situation in an organization as well as knowledge potentials for the future. The framework contains 7 dimensions:

- Maturity of Knowledge
- Knowledge usage
- Maturity of Knowledge Management
- Information Availability
- Maturity of Knowledge Organization
- Information Management
- Conciseness of Knowledge

Every dimension is divided into 5 levels. The 1st level means that this dimension is not well developed; level 5 represents a well developed dimension. In the description below, the single dimensions are explained shortly.

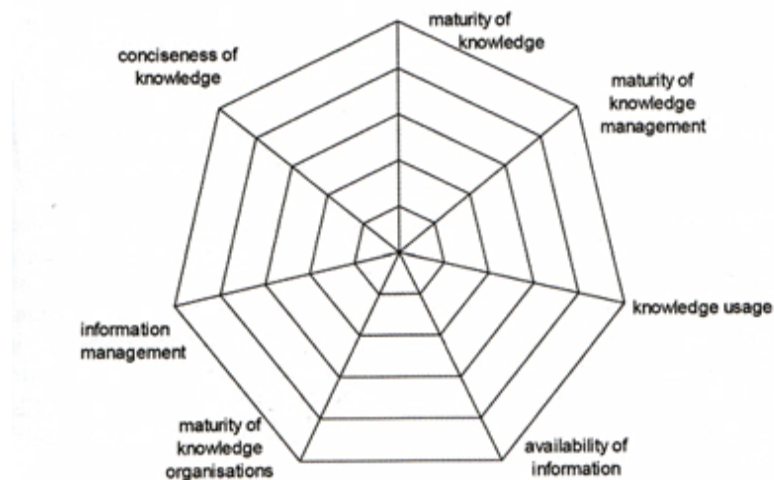


Figure 1: Multi dimensional knowledge assessment framework

**Maturity of Knowledge:** Knowledge Maturing represents the process from the emergence, development and adoption of new ideas until this knowledge becomes standard within the organization. The dimension "Maturity of Knowledge" explains the process in which knowledge is continuously repacked, enriched, shared, reconstructed, translated and integrated across different individual learning processes [Sch05]. The five assessment levels correspond to the phases of the knowledge maturity model: (1) emergence of ideas, (2) consolidation in communities, (3) formalizing, (4) ad-hoc training and (5) standardization.

**Knowledge usage:** The knowledge usage dimension assesses the integration of knowledge management activities into the operational work. This dimension corresponds to the integration of process and knowledge management which is the main focus of process-oriented knowledge management [AHMM02]. The levels of integration are (1) General-purpose storage and retrieval, (2) Fixed link between processes and information objects, (3) Context-dependent knowledge retrieval, (4) Context-dependent, automated knowledge provision, and (5) User-specific and context-adapted knowledge assistance.

**Maturity of Knowledge Management:** Knowledge management is a concept in which an enterprise consciously and comprehensively gathers, organizes, shares, and analyzes its knowledge in terms of resources, documents, and people skills. KMMM<sup>1</sup> (Knowledge Management Maturity Model) is a means to measure the Maturity of Knowledge Management [EL08]. It was developed within Siemens and is a methodology for systematically analyzing, measuring and developing knowledge management. Here we can distinguish the following levels: (1) Initial, (2) Repeatable, (3) Defined, (4) Managed, and (5) Optimizing.

**Information Availability:** Information is an important factor of any organization and central to every process. The dimension of Information Availability covers questions like "is the information explicitly available?" and "is it transparent or even integrated in a defined common data model or unified metadata?". Here we can distinguish the following levels: (1) Explicit documentation, (2) Transparency, (3) Accessibility, (4) Integrated information, and (5) Automated Metadata Generation.

**Maturity of Knowledge Organisation:** It is the objective of knowledge organisation to make knowledge intellectually accessible by using a conceptual structure<sup>2</sup>. In accordance with Daconta et al. [DOS03], methods for knowledge organisation can be arranged in a spectrum with increased semantics: (1) Keywords, (2) Categories, (3) Taxonomy, (4) Thesaurus, and (5) Ontology.

**Information Management:** This dimension considers the structure, security, redundancy, integrity on conflict resolving of information. It has five constructive levels: (1) Structure, (2) Information security, (3) Controlled redundancy, (4) Integrity constraints, (5) Conflict solving and proactive development.

---

<sup>1</sup> <http://www.kmmm.org/>

<sup>2</sup> see International Society for Knowledge Organization, <http://www.isko.org/>

**Conciseness of Knowledge:** In this dimension, the quality of content and the adequacy of the representation of knowledge is assessed. A valuable source which will be used to make the investigation in this dimension is DGIQ<sup>3</sup>. DGIQ provides a list of criteria for measuring the information quality. The multi-dimensional knowledge framework approach selects eleven criteria in order to assess the quality of content. These are: Appropriate amount, Believability, Completeness, Concise representation, Consistent representation, Ease of manipulation, Unambiguous interpretability, Objectivity, Reputation of Source, Timeliness, and Understandability. If a qualitative measurement is required, each criterion can be assessed on a discrete scale between 1 and 5. For an aggregate value an average can be taken.

For more information about every single level and the criteria when a level is reached see [BH09].

### 3 Case study

The business area in which the in-depth study was carried out is Energy Trading and Risk Management (ETRM) of Atel. Atel is a company that operates in Switzerland and Europe in the fields of electricity generation, transmission, sales and trading as well as energy services.

The project for this in-depth study was called EIP (ETRM Implementation Project). The target of EIP was to replace the old ETRM solution with a new one. The project started in 2006 and lasted nearly 3 years – 2 years more than originally planned.

The objective of this study is based on the assumption that one of the reasons for this delay was a neglect of the management of knowledge. Therefore we applied the knowledge maturing framework in a kind of after-project review. We identified several important knowledge topics. Each of these topics was assessed with the framework. Then we wanted to identify whether weaknesses of the project could be explained with low measures of the maturity assessment.

#### 3.1 Project Scope and Objectives

The aim of EIP was to execute the trading process with one single IT system. The Trading process covers different activities from Front-, Middle and Back Office as well as Risk Management. Figure 2 illustrates the scope of EIP and thus the areas covered by the ETRM system.

For every area a Mind Map of the EIP Scope is presented. The tree does not explain every detail, because this would be beyond the scope of this paper. The illustration is presented as an overview of the entire EIP in every area.

---

<sup>3</sup> Deutsche Gesellschaft für Informations- und Datenqualität e.V., [www.dgiq.de/](http://www.dgiq.de/)

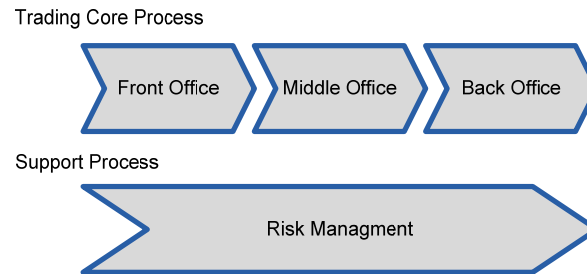


Figure 2. Trading Process of Atel

### 3.2 Scope of the Application Framework

To apply the multi-dimensional knowledge framework, we identified the most important knowledge topics and applied the framework to each of these knowledge topics independently. This allows assessing the applicability of the framework on a more fine-grained level.

Figure 3 shows the knowledge topics together with the process areas they play a role for. All in all 10 knowledge topics were identified which constitute the basis for the application of the knowledge framework:

- Analytical / Methodology knowledge
- Customer knowledge
- Financial knowledge
- IT / Configuration knowledge
- Market knowledge
- Mathematical knowledge
- Process knowledge
- Product knowledge
- Regulations knowledge
- System usage knowledge

For each topic there is both implicit and explicit knowledge. In the following evaluation, however, we only deal with explicit and internal knowledge – knowledge of Atel that is represented in some kind of artefact.

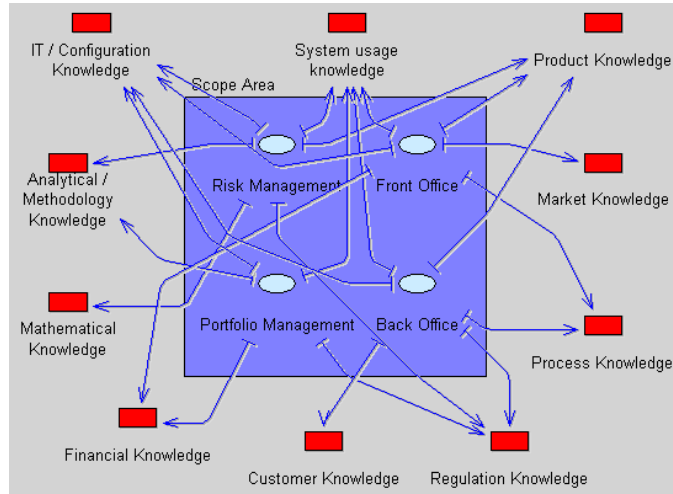


Figure 3: Knowledge topics of the EIP

### 3.3 Application of the Multi-dimensional Knowledge Framework

The evaluation of the application of the multidimensional knowledge framework is based on data as at the 31st of May 2009, the official end date of the project. This should give an answer of how mature the knowledge management of EIP currently is.

The application of the knowledge framework provided on each knowledge topics 7 numbers between 1 and 5. This resulted in 10 spider graphics, one for each knowledge topic (in Figure 4 we show as an example the spider of the product knowledge topic).

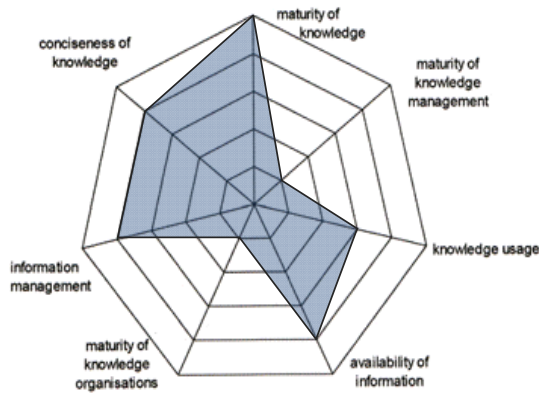


Figure 4. Graphics representing the application of the framework

Instead of the 10 spider graphics, Table 1 presents for all the knowledge topics the level of each dimension of the knowledge framework.

Dimensions / Knowledge Fields	Knowledge Maturity	Knowledge usage	Maturity of Knowledge Management	Information availability	Maturity of Knowledge Organisation	Information Management	Conciseness of Knowledge
Analytical / Methodology	3	2	1	1	1	2	3
Customer	5	2	1	3	2	4	5
Financial	3	2	1	1	2	1	3
IT config.	5	3	1	3	3	4	5
Market	3	1	1	1	1	1	3
Mathematics	5	1	1	3	2	4	4
Process	5	1	1	2	1	3	5
Product	5	3	1	4	1	4	4
Regulations	5	3	1	3	1	3	5
System usage	5	4	1	3	3	5	4

Table 1: Aggregated results of the assessment of the 10 knowledge topics

In the following we discuss the most interesting points of the application of the framework.

**Maturity of Knowledge:** During the project a lot of effort was needed to make the "Maturity of Knowledge" growing in the single knowledge topics. The knowledge was continuously enriched, reconstructed and extended. With the completion of the project, level 5 ("Standardization") had to be reached to make the Go Live possible.

**Knowledge usage:** This dimension ranged mainly between Level 1 and 3 as the knowledge usage is fixed and often manually done by checklists and forms. An exception is the system usage field where the system is able to support the user in his daily work by providing context-dependent, automated knowledge delivery.

**Maturity of Knowledge Management:** Because the company Atel has no knowledge management initiative and knowledge management is not organized in a structured way, the "Maturity of Knowledge Management" dimension reaches level 1 overall.

**Information Availability:** In many knowledge topics the information is indeed explicitly available but not transparent or accessible; in others when it is transparent often it is also accessible. Thus all knowledge topics reached either level 1 or level 3 except the "Process Knowledge" (level 2) and the "Product Knowledge" (level 4).

**Maturity of Knowledge Organisation:** In this dimension the highest level was reached for "IT configuration" and "System usage" (level 3). All the other knowledge topics do either arrange their information by keywords or categories.

**Information Management:** The dimension "Information Management" seems to be well developed. The knowledge topics reached levels mainly on the higher end. The exceptions are the "Financial" and the "Market" topics, where the information was not structured in reports, but separately saved in several Excel files.

**Conciseness of Knowledge:** In this dimension the best results were reached. The levels vary from 3 - 5 and show that the company has a fairly good quality of knowledge.

## 4 Evaluation

The main purpose of the maturing framework is to assess the context of knowledge maturing and thus help to find appropriate tools and avoid barriers for knowledge maturing and learning.

To evaluate the framework we identified several weaknesses and problems but also successful usage of knowledge management and tried to explain them using the framework. If there are low maturity levels in several dimensions then this would be an argument that the dimensions and the definitions of the maturity levels make sense. This argument would be strengthened further, if good knowledge usage coincides with higher maturity assessments.

### 4.1 Basic information for the evaluation

For the collection of the information that is the basis for the evaluation, we used different sources and methods:

- The overall status of the project as well as additional information about project risks, subprojects and other problematic issues were taken from the weekly project management reports.
- Another source of issues was the weekly business meeting where responsible persons from every area - including project management - discussed current topics as well as further developments.
- The third information source was interviews with people from business as well as from project management. These interviews helped to confirm the issues gathered.

### 4.2 Issues considered

In the following we shortly present three of the issues we identified and investigated:

**Report generation:** One of the challenges within EIP was the migration of various reports from the old ETRM system to the new one. During EIP, the structures of the reports were quickly developed, but the development of the content causes many mutually related problems. In order to have accurate data for each report, a lot of mistakes were to be analyzed and corrected; sometimes missing data had to be added to the report afterwards.

The main knowledge fields which are relevant for the development of the reports are the "Analyzing/Methodology", the "Market Knowledge", and the "Financial Knowledge". All three knowledge topics reach only level 1 or 2 in the dimensions "Information Availability" and "Maturity of Knowledge Organization" (cf. Table 1). Thus it can be shown that a lot of important information is missing and additionally communication is problematic. This results in a slow development of the "Maturity



of Knowledge" dimension with the effect that the development and verification process of reporting was delayed.

Solutions derived from this analysis were to make more information explicit and to set up initiatives to increase information exchange and improve the learning processes.

**Project delay and costs:** As in many projects, huge delays and costs was a problem also the case of EIP. When looking at the evaluation it becomes clear that the knowledge management dimension of the related knowledge areas is rated rather low. To prevent project delays and additional costs, for future projects knowledge management initiatives shall be planned at the beginning of large projects.

**Training in the usage of the system:** One of the challenges of EIP was that the user had to be taught the usage of the new system. Especially for this task, a wiki with movies and other multimedia functions was developed. However, a lot of specific functions were not presented and the wiki itself was not often used by the users. The result was that the users were not prepared for the usage of the system.

The project management decided to start some training sessions combined with specific training aligned to the job profile. This knowledge initiative led to an increase in the "Maturity of Knowledge Management" dimension which further on resulted in a rise of the "Maturity of Knowledge" in this topic (see Figure 5). Through the training sessions, the knowledge about system usage was improved.

As can be seen by this evaluation, problems and advancements of knowledge management can be assessed by the knowledge maturing framework. If the maturity dimensions would have been assessed in advance, adequate arrangements could have been applied earlier to avoid the problems encountered.

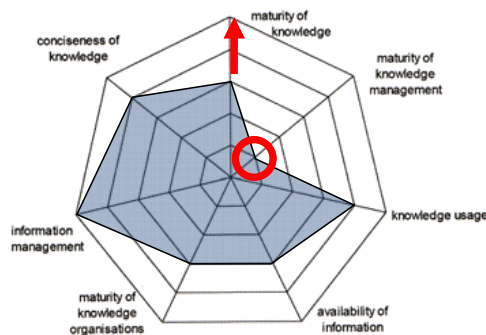


Figure 5: Dependencies and improvements of dimensions

## 5 Conclusion

The application of the multi dimensional knowledge framework gave a lot of hints about how knowledge management could have helped to improve project efficiency and quality. The results are very useful and can give hints about how project execution can be improved. This information should help Atel and other companies to adapt the knowledge management strategies and give guidance about how they can gain benefits from knowledge management.

As a suggestion for further work the framework could be applied in a business team. It would be interesting to see how results could lead to improvements of knowledge management arrangements. As a final point we like to mention that the framework mainly identifies weaknesses and problems, but does not provide any solutions, methods or tools to solve them. These still have to be derived by humans.

## 6 References

- [ABW08] Alwert, K.; Bornemann, M.; Will, M.: Wissensbilanz - Made in Germany. Leitfaden 2.0. Herausgegeben durch das Bundesministerium für Wirtschaft BMWi, Berlin 2008.
- [AHMM02] Abecker, A.; Hinkelmann, K.; Maus, H.; Müller, H.J. (Hrsg.): Geschäftsprozessorientiertes Wissensmanagement. Springer-Verlag, 2002.
- [BHTT09] Brun, R., Hinkelmann, K., Telesko, R. and Thönssen, B.: Towards an Integrated Approach to Assess the Potential of an Enterprise to Mature Knowledge. In: Hinkelmann, K. and Wache, H.: WM2009 - 5th Conference on Professional Knowledge Management, Springer-Verlag, 2009
- [DOS03] Daconta, M. C., Obrst, L. J., and Smith, K. T. (2003). The Semantic Web: A guide to the future ofXML, Web services, and knowledge management. Indianapolis: John Wiley & Sons.
- [EL08] Ehms, K.; Langen, M.: Holistic Development of Knowledge Management with KMMM®, Siemens AG 2002, [http://www.providersedge.com/docs/km\\_articles/Holistic\\_Development\\_of\\_KM\\_with\\_KMMM.pdf](http://www.providersedge.com/docs/km_articles/Holistic_Development_of_KM_with_KMMM.pdf), access: November 6, 2010.
- [MaSc07] Characterizing Knowledge Maturing: A Conceptual Process Model for Integrating E-Learning and Knowledge Management., In: Norbert Gronau (eds.): *4th Conference Professional Knowledge Management - Experiences and Visions (WM '07)*, Potsdam, GITO, 2007, pp. 325-334.
- [MAH05] Mertins, K.; Alwert, K.; Heisig, P. (Hrsg.): Wissensbilanzen - Intellektuelles Kapital erfolgreich nutzen und entwickeln. Springer-Verlag, Berlin, 2005.
- [Nem06] Nemetz, Martin: *Towards a Model for Creating Comparable Intellectual Capital Reports*, Journal of Universal Knowledge Management, Vol. 1, No. 3 pp. 217-234, 2006.
- [Sch05] Schmidt, A., 2005. Knowledge Maturing and the Continuity of Context as a Unifying Concept for Knowledge Management and E-Learning. *Proceedings of I-KNOW 05, Graz, Austria*, 2005